

REMARKS

The present invention is directed to a stacked, bi-layer structure and methods of fabricating a phase shift photomask that has tunable optical transmission, coupled with stable optical properties during usage (photon exposure and chemical treatments) of the photomask, and a superior etch selectivity. The bi-layer structure preferably comprises a etch stop layer and a phase shift layer composition comprising $\text{SiM}_x\text{O}_y\text{N}_z$ materials, where element M represents a metal. Unique to the present invention is the provision of the etch stop layer which comprises a metal material. The use of a metal increases etch selectivity in combination with the underlying industry standard fluoride quartz or otherwise, modified quartz substrate material. Furthermore, the bi-layer structure exhibits improved stability to laser irradiation.

In applicants' commonly-owned, co-pending United States Patent application Ser. Nos. 10/303,341 and 10/122,876 (indicated as allowable), and, in the present continuation application, each of independent Claims 1 and 11 have been amended to include the subject matter of canceled Claims 2 and 12 respectively.

Particularly, independent Claims 1 and 11 have been amended to set forth the novel features of providing a substrate comprising a quartz or fluorinated quartz material; and disposing a thin layer of etch stop layer on the substrate comprising a metal selected from groups II, IV, V, transition metals, lanthanides and actinides, said etch stop layer exhibiting improved etch selectivity; disposing a layer of phase shifter layer on the etch stop layer, the phase shifting layer as comprising a composite material of formula $\text{A}_w\text{B}_x\text{N}_y\text{O}_z$, where A is an

element selected from the group consisting of Groups IVA, VA, or VIA; and B is selected from the group consisting of an element from Groups II, IV, V, the transition metals, the lanthanides and the actinides; wherein w is from about 0.1 to about 0.6, x is from about 0 to about 0.2, y is from about 0 to about 0.6, and z is from about 0 to about 0.7; and wherein the blank is capable of producing a photomask with 180° phase shift and an optical transmission of at least 0.001 % at a selected wavelength of <500nm.

Claim 6 is additionally being amended to remove the recitation of the etch stop layer comprising a metal material which is now wholly incorporated in amended Claims 1 and 11.

While in each of the above-mentioned co-pending applications the Examiner had rejected Claims 1, 2, 5-8, 11-12 and 18-20 under 35 U.S.C. §102 (e) as being anticipated by Smith, applicant respectfully disagrees.

Smith, while directed to attenuating phase shift masks, does not teach a bi-layer structure, but at best, describes in connection with Figure 1(b) a multiple layer structure that has sufficiently thin layers to comprise “pseudo-mono” layer (col. 6, lines 35- 36 of Smith). In one instance, Smith mentions a fluoride film functioning as an etch stop layer, which is not a pure metal. This is in connection with Smith’s Figure 1B (col. 6, lines 50- 55 of Smith) which describes a fluoride component layer 16 (e.g., MgF_2) on top of a fused silica (quartz) substrate. However, Smith neither mentions nor suggests that improved etch selectivity is obtained with the condition of increased stability in terms of chemical cleaning and laser irradiation. This is because fluoride will never be used in industry as an etch stop layer because it is unstable (in terms of laser irradiation), and it is hygroscopic, i.e., sensitive to the moisture it will see during the chemical cleanings. Correspondingly, new Claim 22 (dependent upon structure Claim 1) and new Claim 23 (dependent upon method Claim 11) are

being added to the present application to address the novel feature that etch selectivity is greater than 10:1 with substrates of quartz or fluorinated quartz used with a metal etch stop layer and at the same time have stable optical transmission against chemical cleaning and photon irradiation. The exhibition of improved chemical stability for the bi-layer photomask structure is described on page 9, lines 14-21, and the exhibition of improved optical irradiation stability for the bi-layer photomask structure is described on page 2, lines 8-13, and page 9, lines 27-28, for example. While the description in the specification indicates improved stability at wavelengths of 157 nm, it is inherent that it will be as stable for photons at that wavelength or greater (e.g., 193 nm).

Respectfully, no new matter is being added by the amendments made to Claims 1, 11. Furthermore, the addition of new claims 22 and 23 is fully supported by the specification. More particularly, the etch selectivity data in the present application is described in Figure 8 showing the improved selectivity when a metal etch stop layer, e.g., Ti is provided over a quartz substrate. Applicants respectfully submit that in the present application, the Etch selectivity of Ta/fluorinated (F)-quartz currently has improved even further to about 30:1, similar to the Ti/F-quartz.

Applicants have also amended the specification to include reference to the parent application.

In view of the foregoing remarks herein, it is respectfully submitted that this application is in condition for allowance. Accordingly, it is respectfully requested that this application be allowed and a Notice of Allowance be issued. If the Examiner believes that a telephone conference with the Applicants' attorneys would be advantageous to the disposition

of this case, the Examiner is requested to telephone the undersigned, Applicants' attorney, at the following telephone number: (516) 742-4343.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Steven Fischman", followed by a long horizontal line.

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